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ABSTRACT

In 1993 the National Science Foundation awarded a Louisiana Parish a grant to fund a program to enhance science education in the elementary schools in the school district. Two teachers in each elementary school were to be trained as science mentors or lead teachers receiving instruction in physical science content, hands-on science programs, and training in alternative assessment. These teachers should disseminate this information in their schools. An evaluation of the summer training program for the first 34 science mentors used pretest and posttest scores on a measure of science knowledge, a consumer satisfaction form, observation during the training, and interviews with program staff. Average scores for teacher perceptions of their training on the content dimensions of science were very positive, and posttest scores indicated increased knowledge. Teacher attitudes about the program were generally positive, but some recommendations were made for program improvement based on teacher responses. These include greater emphasis on alternative assessment training, and additional training on some teaching methods and strategies. Seven appendixes list goals, contain the questionnaire, and provide information about the code structure and frequencies for strengths and weaknesses, along with posttest results. (Contains 7 references.) (SLD)

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Evaluation of a Summer Science Institute for Elementary Teachers

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Paper presented at the Annual Meeting of the
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I. Introduction

A. Background of the Louisiana Physical Science Program

In the Summer of 1993, the National Science Foundation awarded a Louisiana Parish a five year $1.7 million program entitled Louisiana Physical Science (LPS). The overall goal of the program is to enhance science education in the elementary schools (focusing on kindergarten through third grade classrooms) in the district.

During the five years of the project, two teachers in each elementary school in the district will be trained either as a Science Mentor or a Lead Teacher. In these roles, the teachers will receive instruction in physical science content, training on how to manage and direct a hands-on, activity-based science program and training in using alternative methods of assessment in science classrooms (LPSS, 1992). To facilitate this teacher training, a series of summer programs have been organized to address each of these areas. It is the methodology and results of the Summer 1993 Program Evaluation that will be the primary focus of this paper.

The LPS grant calls for the gradual diffusion of the proposed innovations in science teaching throughout the entire district. The grant first funded the training of a corps of 34 Science Mentors during the 1993-94 fiscal year. These Science Mentors will then work with the science teachers in all of the public elementary schools in the district. After the first two years, the program will concentrate on the training of 62 Lead Teachers, who will in turn provide training to other teachers in their schools (LPSS, 1992).

An examination of the LPS grant proposal identified seven primary objectives and 31 activities designed to accomplish these objectives (K. T. Associates, 1993). The objectives of

the project, broken out into five teacher-oriented and two student-oriented objectives, are as follows:

Teacher Goal 1. To increase the teacher's knowledge of physical science content.

Teacher Goal 2. To train the teachers to manage and direct a hands-on, activity-based science program.

Teacher Goal 3. To train teachers to use alternative methods of assessment.

Teacher Goal 4. To develop a network of Science Mentors and Lead Teachers that provides collegial support and leadership to each other and to other teachers in their schools.

Teacher Goal 5. To develop a shared vision for the science program among parents and the community that supports the continuance of that program.

Student Goal 1. To develop students' understanding of the habits of mind identified in Science for All Americans (Rutherford and Ahlgren, 1990).

Student Goal 2. To develop students' understanding of the basic concepts of the nine topics outlined in the LPS program.

Activities of the Summer 1993 Program and the Academic year 1993-94 Program concentrated on the attainment of Teacher Goals 1, 2, and 3, plus a partial start on Teacher Goal 5. Neither of the Student Goals were assessed during the first year of the program, during which the emphasis was on staff development. A complete list of the Teacher Goals and Activities is found in Appendix 1, with highlights by those relevant for Academic Year 1993-94 Program.

B. Description of the Summer 1993 Program

The 34 Science Mentors met on a college campus for a three week Summer Program beginning July 12, 1993. Physical science content covered in the Summer 1993 Program centered on four topics: Magnets and Magnetism, Sound, Color and Light, and Matter and Its Changes.

During the three week course, the Science Mentors were taught physical science content using the same strategies and techniques that they were expected to use in their classrooms during the 1993-94 school year. The inquiry-based lessons were designed to feature hands-on activities, open-ended discussions and opportunities for independent investigation (LPSS, 1992).

The physical science content course was taught by a trainer from the American Institute of Physics and utilized materials from the Evlyn J. Daniel Educational Foundation. The Summer 1993 Program included having the Science Mentors work with a student population of 32 children from 16 participating schools in classroom settings on the college campus.

Seminar topics for the Summer 1993 Program included assessment strategies, classroom management, computers in the classroom, an integrated mathematics curriculum and relevant special education topics. The sessions were taught by recognized experts on the discussion topics and by LPS staff members. The Science Mentors were broken out into two groups to attend the seminars: kindergarten and first grade teachers in one group, second and third grade teachers in another group.

C. Goals of the Summer 1993 Program

With regard to the Summer 1993 Program, there were three relevant goals, and three activities, to evaluate. These were as follows:

(1) Teacher Goal 1. To increase the teacher's knowledge of physical science content.

Teacher Activity 1a. Increase teachers' knowledge of physical science content by conducting two Summer programs (Year One, Year Two) for the Science Mentors.

(2) Teacher Goal 2 To train the teachers to manage and direct a hands-on, activity-based science program.

Teacher Activity 2a. Train the teachers to manage and direct a hands-on, activity-based science program by conducting two Summer programs (Year One, Year Two) for the Science Mentors.

(3) Teacher Goal 3 To train the teachers to use alternative methods of assessment.

Teacher Activity 3a. Train the teachers to use alternative methods of assessment by conducting two Summer programs (Year One, Year Two) for the Science Mentors.

II. Evaluation Design and Methodology

A. Evaluation Design

The evaluation design called for the use of pre- and posttest scores on a knowledge test developed to assess the four content areas taught during the Summer 1993 Program under Teacher Activity 1a. A consumer satisfaction form, known as the Science Mentor

Questionnaire (Appendix 2), was developed to assess the accomplishment of Teacher Activities 2a and 3a. This consumer satisfaction form was used to ascertain how adequate the Summer 1993 Program was in training the teachers to develop their own hands-on, activity-based lessons and in training them to use alternative methods of assessment. This evaluation design also utilized observations during the training sessions and interviews with the LPS Summer Program staff as sources of data.

B. Methodology

1. The Science Mentor Questionnaire

The Science Mentor Questionnaire (SMQ) was developed by the LPS staff and evaluation team for use during the Summer 1993 Program and contains a combination of closed-and open-ended questions. The closed-ended items include the following:

(1) Four items assessing the effectiveness of the training that the Science Mentors received in the four physical science content areas taught at the Summer 1993 Program: matter, sound, magnets and light/color. The responses to these items were five point scales with 5 indicating "highly effective". (See the SMQ, Part I in Appendix 2.)

(2) Six items assessing the Science Mentors' perceived ability to demonstrate skills in teaching methods and strategies based on their participation in the Summer 1993 Program. The six teaching methods and strategies that were taught at the Summer 1993 Program were: cooperative learning, reflective logs, use of computers in the science classroom, accommodating individual differences, higher order thinking skills and authentic and/or performance-based assessment. The responses to these items were five point scales with 5 indicating "well prepared". (See the SMQ, Part II in Appendix 2.)

(3) Ten items assessing the Science Mentors' perception of the emphasis placed on different types of learning. The ten types of learning that were taught at the Summer 1993 Program were: learning factual information; developing concepts; understanding and applying principles and rules; understanding and applying theory; critical analysis and/or problem solving; creative thinking; developing knowledge of self and others; developing professional, career and job-related skills; developing written communication skills; and developing oral communication skills.

The responses to these items were three point scales with 3 indicating "a lot of emphasis". (See the SMQ, Part III in Appendix 2.)

(4) Two items assessing the Science Mentors' opinions regarding two issues related to the overall training program: did the teaching methods stimulate their interest in the course; and were thought-provoking questions asked. The responses to these items were five point scales with 5 indicating "strongly agree". (See the SMQ, Part IV in Appendix 2.)

(5) One item assessing the Science Mentors' opinion regarding the overall quality of teaching in the course (Summer 1993 Program). The responses to this item was a five point scale with 5 indicating "excellent". (See the SMQ, Part V in Appendix 2.)

The Science Mentors were also asked open-ended questions about their perceptions of the strengths and weaknesses of the Summer 1993 Program, their suggestions for ways that the program could be improved and their perceptions regarding the presentations of the resource persons. These items are located in Part VI of the SMQ in Appendix 2.

Since the data from the surveys were both numeric (answers to the closed-ended items) and narrative (answers to the open-ended questions) in nature, a combination of

quantitative and qualitative analyses were planned. The quantitative analyses included descriptive statistical analyses of the numeric data using procedures from the SAS data analysis system. Narrative data were analyzed using the constant comparative technique (Lincoln & Guba,1985), which was automated using the Qualpro text management system (Blackman, 1993).

On the closed-ended items, descriptive statistics were first run, including frequencies, means and standard deviations (sds) for the survey items. There were 34 respondents to the SMQ, which represents the entire population of the Science Mentors who attended the Summer 1993 Program. The means and standard deviations for each of these 23 items are included in Appendix 3. The narrative data generated from the open-ended items were analyzed using the constant comparative method, which was automated using Qualpro (Blackman, 1993; Lincoln & Guba, 1985). The code structures and frequencies for the three open-ended items are found in Appendices 4-6.

2. Interview and Observation Data

Interviews with LPS staff members and observations on-site by the evaluation team resulted in several tentative conclusions:

* In general, the LPS staff appeared to have done a very good job of selecting somewhat knowledgeable and enthusiastic Science Mentors for the program.

* The Science Mentors were very impressed with the abilities of the primary trainer for the Summer 1993 Program and wished that they could have spent more time with her.

* The Science Mentors had a much more mixed reaction to the Seminar presentations, with several of them complaining that some of the presentations were irrelevant or redundant.

* The Science Mentor came to the program with a variety of backgrounds in physical science content and in basic knowledge regarding hands-on activities in the classroom and alternative forms of assessment. This resulted in some teachers being bored at times and others feeling overwhelmed.

III. Results

A. Science Mentor Questionnaire

The means for the closed-ended items completed by the Science Mentors were generally positive. The average scores for their perception of their training on the four content areas were very positive.

The scores were somewhat less positive for the items measuring the Science Mentors' perception of their preparation in six areas concerned with teaching methods and strategies. The Science Mentors gave high ratings to their Preparation on Cooperative Learning and on Higher Order Thinking Skills; moderately high ratings on their Preparation on Reflective Logs, on Accommodating Individual Differences and on Authentic Assessment; and a below average score on their Preparation on the Use of the Computer in Science Classrooms. The Science Mentors gave a mean score slightly above the mid-point of the scale to the item regarding their Preparation on Authentic Assessment (See Appendix 3).

The open-ended items on the Science Mentor Questionnaire allowed the Science Mentors to make unstructured comments in three areas: their perceptions of the strengths of the Summer 1993 Program; their perceptions of the weaknesses of the Summer 1993 Program; and their suggested methods of improving the program. The perceived strengths of

the program may be divided into three broad categories: (1) characteristics of the Summer 1993 Program trainers and staff; (2) quality of the information taught; and (3) aspects of the program associated with "working with others in actual settings" (See Appendix 4).

With regard to characteristics of the trainers and staff, the primary trainer was the most frequently mentioned "strength of the program". She received 20% of the total number of all responses regarding strengths of the program by herself.

With regard to the quality of the information taught, the sub-category associated with Content Knowledge was the most often cited, receiving 17% of all responses regarding the strengths of the program. This finding confirms the results from the closed-ended items noted above in which training in specific content areas was rated highly by the Science Mentors.

On the other hand, only 5% of the responses of the Science Mentors named Assessment Training as a strength of the Summer 1993 Program. This is problematic, since one of the major goals of the Summer 1993 training was to begin training the teachers to use alternative methods of assessment (LPSS, 1992; K. T. Associates, 1993).

The most common response from the Science Mentors regarding the weaknesses of the program was the Quality of the Resource Persons, which paradoxically had also been mentioned as a strength of the program. Slightly over 34% of the responses regarding program weaknesses concerned the Quality of the Resource Persons. On another open-ended item regarding the resource persons, the most frequently criticized areas were the computer training, the integrated math training and the special education topics (See Appendix 5).

Several of the cited weaknesses concerned the need for a greater emphasis on some aspect of the program. The two most common responses in this category were the Need for

More Content Knowledge and the Need for More Information on Teaching Methods and Strategies. Thus, while the Science Mentors saw the teaching of physical science content as one of the major strengths of the program, they wanted the program to emphasize it even more. Part of the reason for this was the Science Mentors' stated insecurity about their level of knowledge in the physical sciences, which several said was not stressed in their college preparation programs.

Several of the responses regarding the weaknesses of the program concerned the Sessions being Too Long and there being Too Much Material, with these two sub-categories accounting for 17% of the responses regarding weaknesses of the program. Another perceived weakness of the Summer 1993 Program concerned the stress that some Science Mentors felt in preparing lessons and authentic assessments during the training course.

There were three broad categories of suggested methods for improving the program: (1) Changes in the Topics Covered; (2) Changes in the Teaching Methods Employed; and (3) Changes in Trainers and Resource Persons. Under Changes in Topics covered, two sub-categories (More Content Knowledge, More Demonstration of Methods) were the most frequently given responses, accounting for 34% of the total responses concerning suggested changes.

Another sub-category under Changes in Topics Covered was labelled More Authentic Assessment, and 6% of the total number of were made on this topic. This finding is consistent with other data indicating that several of the Science Mentors were not satisfied with their training in authentic and/or performance based assessment and wanted future Summer Programs to cover this topic much more extensively.

The two most frequently given responses concerning Changes in the Teaching Methods Employed were More "Hands-On" Experiences and More "Sharing" Time. Together, these two sub-categories accounted for 23% of the total number of responses regarding suggestions for improving the program. Under the broad category entitled Changes in Trainers and Resource Persons, the most commonly given suggestion was to have More Teacher Involvement, meaning more involvement of the Science Mentors themselves on the Summer Program (See Appendix 6).

B. Pretest and Posttest Content Area

In order to determine if the Science Mentors' knowledge of physical science content was enhanced as a result of attending the Summer 1993 Program, the primary trainer administered pretests and posttests to all participants. These pretests and posttests were open-ended items.

The 34 Science Mentors were given 30 grades on the pretest and the posttest. These 30 content areas may be found in Appendix 7. These content areas relate to Magnets and Magnetism (12 content areas), Color and Light (14 content areas) and Sound (4 content areas). None of the content areas addressed Matter and Its Changes, which was one of the designated topics to be covered in the Summer 1993 Program.

As indicated in Appendix 7, Science Mentors did considerably better on the posttest than on the pretest. The results may be summarized as follows:

(1) There were positive difference scores for <u>all</u> the content areas, indicating that the average posttest for the Science Mentor was higher than the average pretest scores on all items.

(2) The difference was statistically significant (using the matched-pair t-test) for 26 of the 30 content areas. Of course, statistics books (e.g., Hinkle, Wiersma and Jurs, 1988) caution against using multiple t-tests due to the chance of reporting spuriously significant results. However, in this case the large number of significant results (87% of the total number possible) could not be due simply to violating the overall alpha level for protection against Type I errors.

(3) The differences are highly significant ($p < .0001$) for 21 of the 30 comparisons.

These results indicate that the training from the Summer 1993 Program had a positive effect on the Science Mentors' knowledge of physical science concepts.

IV. Recommendations for Improving the Summer 1994 Program

Based on conclusions from the various data sources described above, the following eight recommendations were made with regard to improving the Summer 1994 Program:

1) Place greater emphasis on training in methods of alternative assessment (authentic and/or performance-based) in the Summer 1994 Program.

2) Provide greater opportunity for the Science Mentors to practice the alternative methods of assessment during the Summer 1994 Program.

3) Provide continued training in content areas, including sending reading material to Science Mentors (in the five areas to be emphasized in the Summer 1994 Program) in advance of the program.

4) Provide the Science Mentors with more intensive training on those teaching methods and strategies that were identified as insufficiently covered in the Summer 1993 Program.

5) Select and train seminar presenters who will deliver sessions that are relevant to the needs of the majority of the Science Mentors in an interesting and non-redundant manner.

6) Allow the Science Mentors themselves more involvement in the training, particularly in the "hands-on" activities.

7) Make the evaluation team responsible for the assessment of knowledge gains during the Summer 1994 Program.

8) Make changes in the proposed Summer 1994 Program schedule that would satisfy legitimate criticisms received from the Science Mentors' assessment of the 1993 program.

V. References

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Appendix 1.

List of Louisiana Physical Science Teacher Goals and Activities: Complete for the Five Years of the Project

This list was developed from a reading of the LPS 1992 proposal to the National Science Foundation and was included in the 1993 evaluation proposal developed by K. T. Associates. For Academic Year 1993-94, there were four relevant activities: Teacher Activities 1b, 2b, 3b, and 5a.

Teacher Goal 1. To increase the teacher's knowledge of physical science content.

Teacher Activity 1a. Increase teachers' knowledge of physical science content by conducting two Summer programs (Year One, Year Two) for the Science Mentor Teachers, and three Summer programs (Year Three, Year Four, Year Five) for the Science Lead Teachers.

**** Teacher Activity 1b. Conduct periodic small group meetings between the Science Specialists and Mentor Teachers to assist in development of teachers' knowledge (Year One, Year Two).

Teacher Activity 1c. Conduct periodic small group meetings between the Science Mentor Teachers and Lead Teachers to assist in development of teachers' knowledge (Year Three, Year Four, Year Five).

Teacher Goal 2. To train the teachers to manage and direct a hands-on, activity-based science program.

Teacher Activity 2a. Train the teachers to manage and direct a hands-on, activity-based science program by conducting two Summer programs (Year One, Year Two) for the Science Mentor Teachers, and three Summer programs (Year Three, Year Four, Year Five) for the Science Lead Teachers.

**** Teacher Activity 2b. Conduct periodic small group meetings between the Science Specialists and Mentor Teachers to assist in the training of teachers to manage and direct a hands-on, activity-based science program (Year One, Year Two).

Teacher Activity 2c. Conduct periodic small group meetings between the Science Mentor Teachers and Lead Teachers to assist in the training of teachers to manage and direct a hands-on, activity-based science program (Year Three, Year Four, Year Five).

Teacher Goal 3. To train the teachers to use alternative methods of assessment.

Teacher Activity 3a. Train the teachers to use alternative methods of assessment by conducting two Summer programs (Year One, Year Two) for the Science Mentor

Teachers, and three Summer Programs (Year Three, Year Four, Year Five) for the Science Lead Teachers.

**** Teacher Activity 3b. Conduct periodic small group meetings between the Assessment Specialist and Science Mentor Teachers to train the teachers to use alternative methods of assessment (Year One, Year Two).

Teacher Activity 3c. Conduct periodic small group meetings between the Science Mentor Teachers and Lead Teachers to train the teachers to use alternative methods of assessment (Year Three, Year Four, Year Five).

Teacher Goal 4. To develop a network of Science Mentor Teachers and Lead Teachers that provides collegial support and leadership to each other and to other teachers in their schools.

Teacher Activity 4a. Conduct periodic small group meetings between the Science Mentor Teachers and Lead Teachers designed to foster collegial support and mutual training (Year Three, Year Four, Year Five).

Teacher Activity 4b. Conduct a three-day session at the end of Year Four, focusing on the development of interdependent relationships among Science Mentor Teachers and Lead Teachers.

Teacher Activity 4c. Conduct a three-day session at the end of Year Five, focusing on maintaining lines of communication between Science Mentor Teachers and Lead Teachers.

Teacher Goal 5. To develop a shared vision for the science program among parents and the community that supports the continuance of that program.

**** Teacher Activity 5a. Administer the *Primarily Science Learning Community Survey* to parents and school advisory councils to identify strengths/weaknesses in the development of a shared vision at the end of Year One.

Teacher Activity 5b. Train Science Mentor Teachers in *Family Science* (an innovative national outreach program that seeks to increase the study of science by elementary students) during the Summer of Year Two.

Teacher Activity 5c. Provide Science Mentor Teachers with training that will enable them to become *Family Science* Leader Trainers during the Summer of Year Three.

Teacher Activity 5d. *Family Science* Leader Trainers (who are also Science Mentor Teachers) will provide Science Lead Teachers with *Family Science* training during Years Four and Five.

Teacher Activity Goal 5e. *Family Science* workshops will be conducted for parents and their children during Years Two through Five.

Appendix 2
Science Mentor Questionnaire

BASC 6001 COURSE EVALUATION NAME_____
JULY 30, 1993

SS#_____

Part I
How effective was the training you received in each of the four content areas? Please circle the appropriate response.

MATTER
5 = HIGHLY EFFECTIVE
4
3 = AVERAGE
2
1 = HIGHLY INEFFECTIVE

SOUND
5 = HIGHLY EFFECTIVE
4
3 = AVERAGE
2
1 = HIGHLY INEFFECTIVE

MAGNETS
5 = HIGHLY EFFECTIVE
4
3 = AVERAGE
2
1 = HIGHLY INEFFECTIVE

LIGHT AND COLOR
5 = HIGHLY EFFECTIVE
4
3 = AVERAGE
2
1 = HIGHLY INEFFECTIVE

Part II
How well prepared are you to demonstrate the following skills based on participation in this course?

COOPERATIVE LEARNING
5 = WELL PREPARED
4 =
3 = SOMEWHAT PREPARED
2 =
1 = NOT PREPARED AT ALL

REFLECTIVE LOG
5 = WELL PREPARED
4 =
3 = SOMEWHAT PREPARED
2 =
1 = NOT PREPARED AT ALL

USE OF COMPUTER IN THE SCIENCE CLASSROOM
5 = WELL PREPARED
4 =
3 = SOMEWHAT PREPARED
2 =
1 = NOT PREPARED AT ALL
ACCOMMODATING INDIVIDUAL DIFFERENCES
5 = WELL PREPARED

3 = SOMEWHAT PREPARED

1 = NOT PREPARED AT ALL
HIGHER ORDER THINKING SKILLS
5 = WELL PREPARED

3 = SOMEWHAT PREPARED

1 = NOT PREPARED AT ALL
AUTHENTIC AND/OR PERFORMANCE BASED ASSESSMENT
5 = WELL PREPARED
3 = SOMEWHAT PREPARED
1 = NOT PREPARED AT ALL
Part III
How much emphasis was placed on the following types of learning?
3 = A lot of emphasis
2 = Some emphasis
1 = No much emphasis at all
Learning factual information
3 = A lot of emphasis
2 = Some emphasis
1 = No much emphasis at all
Developing concepts
3 = A lot of emphasis
2 = Some emphasis
1 = No much emphasis at all
Understanding and applying principles and rules
3 = A lot of emphasis
2 = Some emphasis
1 = No much emphasis at all
Understanding and applying theories
3 = A lot of emphasis
2 = Some emphasis
1 = No much emphasis at all
Critical analysis and/or problem solving
3 = A lot of emphasis
2 = Some emphasis
1 = No much emphasis at all
Creative thinking
3 = A lot of emphasis
2 = Some emphasis
1 = No much emphasis at all

Develcping knowledge of self and others
3 = A lot of emphasis
2 = Some emphasis
1 = No much emphasis at all
Developing professional, career, and job-related skills
3 = A lot of emphasis
2 = Some emphasis
1 = No much emphasis at all
Developing written communication skills
3 = A lot of emphasis
2 = Some emphasis
1 = No much emphasis at all
Developing oral communication skills
3 = A lot of emphasis
2 = Some emphasis
1 = No much emphasis at all
Part IV
Teaching methods stimulate interest in the course.
5 = Strongly agree
4 =
3 = Agree somewhat
2 =
1 = Strongly disagree
Thought-provoking questions are asked.
5 = Strongly agree
4 =
3 = Agree somewhat
2 =
1 = Strongly disagree
How would you grade the quality of teaching in this course?
5 = Excellent
4 = Good
3 = Average
2 = Below average
1 = Poor
Part V. Open-ended Questions

1. What are the strengths of this course?

2. What are the weaknesses of this course?

3. How could this course be improved? What specific changes would you make?

Appendix 3

Comparison of Mean Scores for Common Items on the Louisiana Physical Science Mentor Questionnaire, Summer 1993 Program and the Spring 1994 Mentor Questionnaire (S94MQ)

Science Mentor Questionnaire Item	Mean Score Summer 93 Program	Mean Score AY 93-94 Program	Difference
(1) Training on Matter	4.50	4.54	.04
(2) Training on Sound	4.35	4.40	.05
(3) Training on Magnets	4.76	4.81	.05
(4) Training on Light and Color	4.88	4.65	-.23
(5) Preparation on Cooperative Learning	4.21	4.38	.17
(6) Preparation on Reflective Log	3.47	3.15	-.32
(7) Preparation on Use of Computer	2.71	2.96	.25
(8) Preparation on Accommodating Individual Differences	3.62	3.73	.11
(9) Preparation on Higher Order Thinking Skills	4.00	4.35	.35
(10) Preparation on Authentic Assessment	3.44	3.50	.06
Average Across All Items	3.99	4.05	.06

Note. The responses to items 1 through 4 were on five point scales with 5 indicating "highly effective". The responses to items 5 through 10 were on five point scales with 5 indicating "well prepared". The Summer 1993 responses were from the 34 Mentors who enrolled in the program; the Academic Year 1993-94 responses were from the 32 Mentors who were active in April-May 1994.

Appendix 4

Code Structure and Frequencies for the Strengths of the Summer 1993 Program

Response Category		Responses	Percent
1(a)	Primary Trainer (PT)	22	20%
1(b)	Quality of Resource Persons (QRP)	13	12%
1(c)	Quality of Staff (QS)	6	5%
2(a)	Content Knowledge (CK)	19	17%
2(b)	Teaching Methods and Strategies (TMS)	17	15%
2(c)	Assessment Training (AT)	5	5%
3(a)	Working with Other Teachers (WOT)	13	12%
3(b)	"Hands On" Experience (HE)	8	7%
3(c)	Working with Students (WS)	7	6%
		110	100%

110 Units, 9 Codes
Four most common responses:

Primary Trainer	(22)
Content Knowledge	(19)
Teaching Methods and Strategies	(17)
Quality of Resource Persons	(13)*
Working with Other Teachers	(13)*

Note. Due to rounding, the individual percents may not add to 100%. The * means tied for 4th most common response.

Appendix 5

Code Structure and Frequencies for the Weaknesses of the Summer 1993 Program

Response Category		Responses	Percent
1	Quality of Resource Persons (QRP)	22	34%
2(a)	Need More Content Knowledge (NCK)	6	9%
2(b)	Need More Teaching Methods and Strategies (NTMS)	3	5%
2(c)	Need More Primary Trainer (NPT)	3	5%
2(d)	Need More Training in Various Categories (NVC)	5	8%
3(a)	Sessions Too Long (STL)	6	9%
3(b)	Too Much Material (TMM)	5	8%
4	Stress over Assignments (SA)	6	9%
5	Other Weaknesses (OW)	8	13%
		64	100%

64 Units, 9 Codes
Four most common responses:

Quality of Resource Persons	(22)
Other Weaknesses	(8)
Need More Content Knowledge	(6)*
Sessions Too Long	(6)*
Stress over Assignments	(6)*

Note. Due to rounding, the individual percents may not add to 100%. The * means tied for 3rd most common response.

Appendix 6

Code Structure and Frequencies for the Suggested Methods for Improving the Program

Response Category	Responses	Percent
1(a) More Content Knowledge (MCK)	14	18%
1(b) More Demonstration of Methods (MDM)	13	16%
1(c) More Authentic Assessment (MAA)	5	6%
1(d) Cover Fewer Topics (CFT)	3	4%
1(e) More Leadership Training (MLT)	2	3%
2(a) More "Hands-On" Experiences (MHE)	10	13%
2(b) More "Sharing" Time (MST)	8	10%
2(c) Make Changes in Schedule (MCS)	5	6%
2(d) More Work with School Partner (WSP)	3	4%
2(e) Other Organization of Groups (OOG)	2	3%
3(a) More Teacher (Science Mentor) Involvement (MTI)	7	9%
3(b) More Primary Trainer (MPT)	3	4%
3(c) Change in Resource Persons (CRP)	3	4%
3(d) More Principal Involvement (MPI)	1	1%
	79	100%

79 Units, 15 Codes
Four most common responses:

More Content Knowledge	(14)
More Demonstration of Methods	(13)
More "Hands-On" Experiences	(10)
More "Sharing" Time	(8)

Note. Due to rounding, the individual percents may not add to 100%.

Appendix 7

Results from the Pre-Posttests of Content Knowledge

Content Area	Difference in Means	Standard Error	t value	Signi-ficance Level
Law of Magnetic Poles	.61	.13	4.9	.0001
Not Charged	.03	.08	0.4	ns
No Monopoles	.65	.15	4.4	.0001
Multiple Poles	.18	.10	1.8	ns
Magnetic Domains	.76	.10	7.4	.0001
Magnetic Induction	.74	.14	5.4	.0001
Temporary Magnetism	.06	.06	1.0	ns
Relative Strength	.68	.11	5.8	.0001
Compass as a Tool	.94	.10	9.1	.0001
Pole Reversal	.97	.09	10.9	.0001
Pole Names	.71	.12	6.1	.0001
Magnet vs. Magnetic	.29	.15	2.0	ns
Linear Property of Light	.59	.15	3.8	.0005
Converging Lenses	.97	.17	5.8	.0001
Diverging Lenses	.41	.13	3.1	.005
Refraction of Light	.74	.15	5.0	.0001
Image Formation	.88	.14	6.1	.0001
Image Location	.47	.14	3.5	.005
Focus Point of Lenses	.91	.15	6.1	.0001
Shadow Formation	1.18	.20	6.0	.0001
Location of Light Source	.79	.17	4.7	.0001

Absorption of Light	.82	.15	5.5	.0001
Reflection of Light	.97	.18	5.5	.0001
Colors of Light	1.26	.14	8.9	.0001
Colors of Pigment	1.32	.15	8.8	.0001
White & Black	.50	.15	3.4	.005
Sound Production	.74	.13	5.7	.0001
Pitch Frequency	.82	.15	5.5	.0001
Loudness/ Amplitude	.29	.12	2.4	.05
Length of Sound Sources	.71	.15	4.7	.0001